CLAIMS

1. A processing apparatus for removing an oxide film, comprising:

a susceptor on which an object to be processed is disposed;

a process chamber housing said susceptor; and

a mechanism for removing oxide films formed on a surface of the object;

wherein said mechanism for removing the oxide films include:

an activated gas forming device for forming an activated gas from N_2 gas, H_2 gas and NF_3 gas;

an introducing device for introducing the activated gas formed in said activated gas forming device onto a surface of the object disposed on said susceptor arranged within said process chamber; and

a heating device for heating the object to temperatures at which reaction films resulting from reaction between the oxide films formed on the surface of the object and the activated gas introduced into the process chamber are sublimated.

2. The processing apparatus according to claim 1, wherein said activated gas forming device includes:

a plasma generating device for converting the supplied gas into plasma;

a gas supply device for supplying N_2 gas and H_2 gas into said plasma generating device;

an activated species forming device for converting the plasma generated from the plasma generating device into activated species; and

an activated gas forming device for supplying an NF_3 gas into the activated species of N_2 gas and H_2 gas formed in said activated species forming device so as to form activated gases of N_2 gas, H_2 gas and NF_3 gas.

3. The processing apparatus according to claim 1, wherein the oxide film formed on the surface of the object is a native oxide film formed by the reaction with the air atmosphere during the predetermined process steps applied to the object.

4. The processing apparatus according to claim 3, wherein said activated gas forming device includes:

a plasma generating device for converting the supplied gas into plasma;

a gas supply device for supplying N_2 gas and H_2 gas into said plasma generating device;

an activated species forming device for converting the plasma generated from the plasma generating device into activated species; and

an activated gas forming device for supplying an NF_3 gas into the activated species of N_2 gas and H_2 gas formed in said activated species forming device so as to form activated gases of N_2 gas H_2 gas and NF_3 gas, and

wherein the heating device for heating the object

is for heating the object to temperatures at which the native oxide films formed on the surface of the object react with the activated gas introduced into the process chamber and the resultant reaction films are sublimated.

5. The processing apparatus according to claim 4, wherein said plasma generating device is equipped with a mechanism for converting a gas into a plasma by utilizing a microwave.

6. The processing apparatus according to claim 4, wherein said activated gas forming device includes:

a pipe made of microwave transmitting material; and

a supply section of a microwave and a supply section of an N_2 gas and H_2 gas formed at the inlet port of said pipe.

7. The processing apparatus according to claim 4, wherein an introducing mechanism for introducing said activated gas onto the surface of the object disposed on the susceptor arranged in the process chamber includes a guide arranged at the outlet port of said activated species forming device for guiding the activated gases of the N_2 gas, H_2 gas and NF_3 gas onto the surface of the object.

8. The processing apparatus according to claim 4, wherein those walls of said activated gas forming device, said introducing mechanism and said process

chamber which are brought into contact with said activated gas are formed of an electrically insulating material.

9. The processing apparatus according to claim 4, wherein said heating device heats said susceptor so as to elevate the temperature of the object disposed on the susceptor to temperatures at which said reaction films are sublimated.

10. A surface treatment method comprising the steps of:

carrying a subject to be treated, which has an oxide on a surface thereof, into a treatment vessel;

evacuating the treatment vessel to produce a vacuum;

introducing gas containing N and H gases into a plasma generation section, generating plasma from the gas, and activating the plasma to form an activated gas species of N and H gases;

causing the activated gas species to flow toward the subject and adding an NF_3 gas to the activated gas species to generate an activated gas of NF_3 gas;

cooling the subject to not higher than a predetermined temperature; and

reacting the activated gas of NF_3 gas, with the oxide on the surface of the subject to degenerate the oxide into a reactive film.

11. The surface treatment method according to

claim 10, wherein the gas containing N and H gases is a mixture gas of N_2 and H_2 gases, and the method further comprises the steps of

stopping supply of N_2, H_2 and NF_3 gases into the treatment vessel and heating the subject to a predetermined temperature to sublimate the reactive film, after the step of degenerating the oxide into the reactive film; and

stopping evacuation of the treatment vessel and taking the subject, from which an oxide film is removed, out of the treatment vessel.

12. The surface treatment method according to claim 10, wherein the predetermined temperature at which the subject is cooled, is not higher than room temperature.

13. The surface treatment method according to claim 10, wherein the predetermined temperature at which the subject is cooled, ranges from 20℃ to -20℃.

14. The surface treatment method according to claim 10, wherein the predetermined temperature at which the subject is cooled, ranges from 10℃ to -20℃.

15. The surface treatment method according to claim 11, wherein the predetermined temperature at which the reactive film is sublimated, is not lower than 100℃.

16. A surface treatment apparatus comprising:

a plasma generation section for generating plasma

from a plasma generating gas;

a treatment vessel connected to the plasma generation section and including a susceptor on which a subject to be treated is placed;

cooling means for cooling the subject placed on the susceptor to a predetermined temperature;

lifting means for lifting the subject to a heating position in the treatment vessel; and

heating means for heating the subject to a predetermined temperature in the heating position.

17. The surface treatment apparatus according to claim 16, which is an apparatus for removing a native oxide film from a surface of the subject to be treated.

18. The surface treatment apparatus according to claim 16, further comprising:

a plasma generating gas introduction section for introducing N_2 and H_2 gases to the plasma generation section as a plasma generating gas; and

an NF_3-gas supply section for adding an NF_3 gas to an activated gas species of N_2 and H_2 gases activated by the plasma generation section and caused to flow toward the subject to be treated,

wherein an activated gas of NF_3 gas is generated by adding the NF_3 gas to the activate gas species, and the activated gas is reacted with a surface layer of the subject to degenerate the surface layer.

19. The surface treatment apparatus according to claim 16, further comprising:

claim 16, wherein the predetermined temperature at which the subject placed on the susceptor is cooled, is not higher than room temperature.

20. The surface treatment apparatus according to claim 16, wherein the predetermined temperature at which the subject placed on the susceptor is cooled, ranges from 20℃ to -20℃.

21. The surface treatment apparatus according to claim 16, wherein the predetermined temperature at which the subject placed on the susceptor is cooled, ranges from 10℃ to -20℃.

22. The surface treatment apparatus according to claim 16, wherein the predetermined temperature at which the subject is heated at the heating position, is not lower than 100℃.

23. The surface treatment apparatus according to claim 16, wherein the NF_3-gas supply section includes a number of gas exhaust holes formed in an inner wall of the treatment vessel.

24. The surface treatment apparatus according to claim 16, wherein the NF_3-gas supply section includes a shower head having a number of gas exhaust holes provided in the treatment vessel.

25. The surface treatment apparatus according to claim 16, wherein the NF_3-gas supply section supplies the NF_3 gas to the activate gas species in position at least 20 cm away from an end of the plasma

generation section in a direction of the subject to be treated.

26. The surface treatment apparatus according to claim 16, wherein the heating means is heat radiation means provided above the subject to be treated.

27. The surface treatment apparatus according to claim 16, wherein the heating means is a heating lamp provided above the subject to be treated.

28. The surface treatment apparatus according to claim 16, comprises a cluster system including at least one metal-wiring forming chamber, a heating chamber, and a load-lock chamber such that the subject is carried through a carrier chamber in an unreactive atmosphere.

29. The surface treatment apparatus according to claim 16, comprises a cluster system including at least one metal-wiring forming chamber, a heating chamber, a cooling chamber, and a load-lock chamber such that the subject is carried through a carrier chamber in an unreactive atmosphere.

30. The surface treatment apparatus according to one of claims 28 and 29, wherein the metal-wiring forming chamber is a chamber for forming a film of at least one of Al, Ti, TiN, Si, W, WN, Cu, Ta, TaN and SiN.

31. The surface treatment apparatus according to one of claims 28 and 29, wherein the metal-wiring

forming chamber includes means for heating the subject to a temperature of 100℃ or higher.